



Helsinki 09.Sep.2016

Ref. Authors' response to Referee comments on the ACPD manuscript titled "*Pan-Eurasian Experiment (PEEX): Towards holistic understanding of the feedbacks and interactions in the land - atmosphere - ocean- society continuum in the Northern Eurasian region*"

Dear Editor,

Thank you for the possibility to revise and submit our ACPD manuscript Lappalainen et al. "*Pan-Eurasian Experiment (PEEX): Towards holistic understanding of the feedbacks and interactions in the land - atmosphere - ocean- society continuum in the Northern Eurasian region*" for Journal of Atmospheric Chemistry and Physics - PEEX Special issue. We also thank the two anonymous reviewers for constructive comments on our manuscript. In the following, we have responded to the associate editors and the reviewers' comments point-by-point (Annex 1, 2), and the corresponding changes has been applied to the manuscript (indicated by red font). We have also included some other corrections or improvements, which are introduced and listed after referee comments in Annex 3. We hope that the revised manuscript version could be considered for publication in the J.ACP.

Sincerely,

Hanna Lappalainen on behalf of all authors
University of Helsinki / Finnish Meteorological Institute

cc: Veli-Matti Kerminen
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ANNEX-1 Anonymous Referee 1

1. Introduction, line 100: replace “will” with “is”
AUTHORS’ RESPONSE: corrected according to referee comment
2. Introduction, line 103-104: consider removing the sentence
AUTHORS’ RESPONSE: the sentence has been removed.
3. Create “Table of contents”
AUTHORS’ RESPONSE: We have added the “Table of contents” after the “Abstract” section
4. Chapter 2, lines 132-135; consider removing, no concrete information
AUTHORS’ RESPONSE: we would like to keep this sentence.
5. Chapter 2, line 250. What does the figure 2 do with the information in this paragraph, explain’
AUTHORS’ RESPONSE: We have added the following sentence to clarify the link between text and Fig.2: “Liners trends in the annual maximum Normalized Difference Vegetation Index (NDVI) over 15 years in the Northern areas of the Yamalo-Nenets, Okrug region in Russia provides supporting evidence of the increasing biological activity and greening and potential to enhanced BVOC emissions (Fig.2). Furthermore, we have added the following to the figure 2. caption” Figure 2: Linear trends in the annual maximum Normalized Difference Vegetation Index (NDVI) obtained from analysis of the MODIS 0.25 km data product for 2000-2014 over the North-Western Siberia region in Russia. The trends are given in the NDVI changes per 15 years. The yellow colors show the decreasing NDVI, which corresponds to decreasing biological production; the blue colors show the increasing NDVI. More detailed analysis of the trends is given in Esau et al. (2016).
6. Chapter 2, lines 251-252. What does “turnover of soil carbon stocks” mean? Please explain
AUTHORS’ RESPONSE: We have removed following text “and in the turnover of soil carbon stocks”.
7. Chapter 2, lines 275-284. Arctic “Browning” vs. “greening. Which process is today dominating area-wise? On line 1168 you are stating that the greening dominates, but this is not clear here. Please clarify
AUTHORS’RESPONSE: We have added the reference Phoenix, G.K., and J.W. Bjerke, J.W.:Arctic browning: extreme events and trends reversing arctic greening, *Global Change Biology*, 22, 2960–2962, 2016. And modified the lines 275-252 as following:

“However, **browning** as a proxy of decreased productivity **has been** observed during recent decades in many boreal regions (Lloyd and Bunn 2007), including vast territories of Central Siberia together with a general downward trend in basal area increment after the mid-20th century (Berner et al., 2013) and **the overall decline in greenness from 2011 to 2014 in Arctic regions (Phoenix and Bjerke 2016)**. Current predictions on the extent and magnitude of these processes vary significantly (Tchebakova et al., 2009; Hickler et al., 2012; Shvidenko et al., 2013). It has been estimated that the northward shift of bioclimatic zones in Siberia will be as large as 600 km by the end of this century (Tchebakova et al., 2009). By taking into account that the natural migration rate of boreal tree species cannot exceed 200-500 m per year, such a forecast implies major vegetation changes in huge areas. **In addition, we need to have a deeper understanding on the future role of the browning process and re-analyze the model predictions of arctic greening; to what extent are they wrong, and why (Phoenix and Bjerke 2016).**”



Figure 3. Very low resolution of map. Please improve

AUTHORS' RESPONSE: we provide an improved version of the map

8. Chapter 2, lines 508-510. The stable atmospheric stratification, is that high pressure subsidence inversions, or other types? Please mention which type of large-scale stratification it is.

AUTHORS' RESPONSE: Stable stratification is typical phenomena in the night time during summer. In Siberia, stable stratification takes place in the winter time and is independent on pressure . The text is modified accordingly.

There is no strong correlation between the atmospheric air stratification and type of air masses. These are different measures to characterize the atmosphere. Temperature inversions are formed in high pressure air masses in clear sky conditions, which enables the cooling of ground surface, commonly during nighttime and early morning. Stable atmospheric stratification can form also in other type of air masses, e.g. low pressure air masses with low winds or calm during nighttime. Atmospheric stability is characterized by Pasquill stability classes according to various meteorological parameters.

<https://www.ready.noaa.gov/READYpgclass.php>

<http://onlinelibrary.wiley.com/doi/10.1002/9780470935361.app1/pdf>

https://en.wikipedia.org/wiki/Outline_of_air_pollution_dispersion

9. Chapter 2.2.3.2, How can the general electric circuit be used as diagnostic tool for climate studies. Please explain and give references."

AUTHOR' RESPONSE: We have added a reference Mareev E.: Global electric circuit research: achievements and prospects, Uspekhi Fizicheskikh Nauk and P N Lebedev Physics Institute of the Russian Academy of Sciences, Physics-Uspekhi, 53, 504- 511, DOI: 10.3367/UFNe.0180.201005h.052 and edited the text as following: Further exploration of the GEC to be part of the climate sytem studies, its effect on the balance between Earth ionosphere and global circuit, requires accurate modeling of the GEC stationary state and its dynamics (Mareev 2010).

10. Chapter 2, lines Line 774-775 "the higher temperature response of aquatic ecosystems compared to terrestrial..." How do you know that the temperature response is higher for aquatic ecosystem?

AUTHORS' RESPONSE: Yvon-Durocher et al., 2012 have used large dataset respiratory measurements demonstrating and showed "show that the sensitivity of ecosystem respiration to seasonal changes in temperature is remarkably similar for diverse environments encompassing lakes, rivers, estuaries, the open ocean and forested and non-forested terrestrial ecosystems, with an average activation energy similar to that of the respiratory complex³. By contrast, annual ecosystem respiration shows a substantially greater temperature dependence across aquatic versus terrestrial ecosystems that span broad geographic gradients in temperature.". We have added "observed": The observed higher temperature response of aquatic ecosystems

11. Chapter 2.4.3 "The impact of climate parameters, such as temperature (including sea seasonal, weekly), strong winds, snowfall, snowstorms and precipitation should be investigated. Both the frequency and the duration of weather extremes... incidence of diseases". Not convincing that the climate change major negative effect on human health in northern Eurasia. If your

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conclusion is that climate change is not affecting human health in a major negative way in northern Russia. Please write this out.

AUTHORS' RESPONSE: We modified the text as following: the living conditions mostly in Eastern part of the Northern Eurasian societies,

12. Chapter 3.2. The acronyms NPP and HSR should be defined the first time these are mentioned.

AUTHORS' RESPONSE: we have defined the acronyms: terrestrial net primary production (NPP) and heterotrophic soil respiration (HSR)

13. Lines 1191-1194. Serious misspellings´

AUTHORS' RESPONSE:We have corrected the text as following: At the same time the fluvial export by the largest rivers considered to be an order of magnitude less than coastal erosion in the East Siberian Arctic Shelf (Semiletov et al, 2011). The Lena's particulate organic carbon export is two orders of magnitude less than the annual input of eroded terrestrial carbon onto the shelf of the Laptev and East Siberian seas.

14. Chapter 3.4 Lines 1276-1283 is a repetition of the previous paragraph

AUTHORS' RESPONSE: To avoid a repetition we have removed the sentence: "Southwestern Siberian soils have lately been reported to contain high concentrations of plant-available phosphorus (Achant et al., 2013), which may enhance carbon sequestration of the ecosystems, if nitrogen is not too limited."

15. Chapter 4 Lines 1378-1393. What is it you are really trying to communicate in this paragraph.

It is general, that it becomes very hard to understand. Please concretize

AUTHORS' RESPONSE: We have shorten and edited the text as follows:

"PEEX is interested in developing methodologies for integrating natural science and social science knowledge as part of the operational Earth sustainable system questions (Schellnhuber et al. 2004). The first-priority tasks in this case is to establish an integrated geographical information background (Ribeiro et al., 2009; Hunt and Sanchez-Rodriguez, 2009; Shvidenko et al. 2010; Skryzhevskaya et al., 2015). A common information background would be the first step serving the development of a common language of integrated studies. For example, we need spatially and temporally explicit descriptions of terrestrial ecosystems, landscapes, atmosphere and hydrosphere. A common information background would be a unified base for the PEEX modelling platform and for the development of integrated modelling clusters, which could combine ecological, economic and social dimensions. It could provide a historical background for the future trajectories of land cover, state and resilience of ecosystems, stability of landscapes, and dynamics of environmental indicators of environment. The already existing Integrated Land Information System could be utilized here for combining all historical knowledge about the region and all scientific results obtained by past, current and future studies across the region (e.g. Schepaschenko et al., 2011; Shvidenko and Schepaschenko, 2014)."

16. Introduction: please write at the end of the introduction chapter what is the outline of your report. In other words_ describe shortly what is the goal of different chapters in order for the reader to get a full picture of how the report is organized and how the different parts connect.

AUTHORS' RESPONSE: To clarify the structure of the paper we have added the "Table of Content" before the "Introduction". The structure and goals of the different chapters is introduced in the three last paragraphs of the Section "2.System perspective approach". We think that now having the "Table of Content", as proposed by the both referees, clearly



provides the full picture of the report, it's goals are, connections between different parts. The introduction of the report fits better to the end of chapter-2 than in the end of "Introduction". Having it in Chapter 2. we are addressing the "system based" orientation of the approach.



ANNEX-1 Anonymous Referee 2

Anonymous Referee 2

1. Page 34, line 1314; you mention that “Sulfur emissions in China are rapidly increasing”. Please give some references about it. As I know, the emissions of NO₂ is increasing rapidly in China, while the increasing of SO₂ is complex after 2008 Olympic Games.
AUTHORS’ RESPONSE: We refer to Lu & Zhang: Sulfur dioxide and primary carbonaceous aerosol emissions in China and India, Atmos. Chem. Phys., 11, 9839-9864, 2011 where they say that ”SO₂ emissions first increased by 61 % to 34.0 Tg in 2006, and then decreased by 9.2 % to 30.8 Tg in 2010 due to the wide application of flue-gas desulfurization (FGD) equipment in power plants.”. The text has been modified as following: ”
“For example, sulfur emissions in China creased rapidly until 2006, and then decreased by 9.2 % to 30.8 Tg in 2010 due to the wide application of flue-gas desulfurization (FGD) equipment in power plants (Lu and Zhang 2011), while emissions in Europe have significantly decreased during the last decades.”
2. Page 2 line 76 “Craduate University of Chinese Academy of Sciences” as “Graduate University of Chinese Academy of Sciences”
AUTHORS’ RESPONSE: corrected
3. Fig 2 & Fig 3 with low resolution are not clear as other picture, please update them.
AUTHORS’ RESPONSE: new higher resolution figures are provided.
4. Page 6 line 189: spelling mistake of “atmosphere”
AUTHORS’ RESPONSE: corrected

ANNEX 3 Other corrections

- We have re-made the language checking.
- We have added Prof. Meinrat O. Andreae, MaxPlanck Institute, in our co-.author list
- Last name of Ella-Maria Kyrö is changed to Ella-Maria Duplissy